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QUANTITATIVE MINERALOGY OF PINE POINT TAILINGS

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ABSTRACT

A quantitative mineralogical investigation of the tailings from the Pb-Zn plant at Pine Point Mines, N.W.T. indicated that 40% of the sphalerite and 23% of the galena is in grains that contain more than 80 area % sphalerite and galena respectively. Grain size analysis shows that the locked sphalerite is 79% +74 μm while the locked galena is 84% +74 μm. It is interpreted that grinding the tailings to 100% -74 μm would liberate most of the sphalerite and galena.

ÉTUDE MINÉRALOGIQUE QUANTITATIVE DES RÉSIDUS DE PINE POINT

par

J. Wilson et W. Petruk

RÉSUMÉ

Les résultats de l'étude minéralogique quantitative des résidus de traitement de l'usine Pb-Zn de Pine Point (T. N.-O.) ont démontré que 40 % de la sphalérite et 23 % de la galène se présentent sous forme de grains qui contiennent plus de 80 % de sphalérite et de galène respectivement. Les résultats de l'analyse granulométrique montrent que la portion de sphalérite est de 79 % +74 µm tandis que celle de la galène est de 84 % +74 µm. Il résulte que le broyage des résidus à 100 % -74 µm libérerait la majeure partie de la sphalérite et de la galène.

PINE POINT TAILIING

M. Cristovici of the Ore Dressing Section submitted a sample of the tailings of the Pb-Zn plant of Pine Point Mines, N.W.T. for quantitative mineralogical analysis. He requested a liberation analysis of the lead and zinc-bearing minerals in order to assess whether it is possible to improve recoveries of these minerals from the tailings. This work is part of project 3.0.1.3.04 - Improved Recovery Technology of Fine Particles.

METHOD OF ANALYSIS

The sample received appeared to be fine-grained and of uniform composition so that a single polished section was deemed adequate for this investigation. Nevertheless an ore minerals concentrate was prepared using a heavy-liquid with a specific gravity of 3.3, a polished section was made of the sink portion. The polished sections of the sample received and of the ore minerals concentrate were examined by ore microscope, SEM and image analyzer. X-ray diffraction analysis was performed on both products.

RESULTS

The heavy-liquid separation produced a sink product of 0.70% by weight of the head sample.

The size distribution and chemical assays were provided by M. Cristovici and are shown in Table 1.

Table 1. Size distribution, assays and metal distribution of tailings

Size Tyler Mesh	Size µm	Wt %	% Zn	% Pb	Zn Recovery %	Pb Recovery %
+ 60	+250	13.1	0.95	0.11	22.5	9.7
+100	+150	19.5	1.23	0.20	43.4	26.3
+150	+100	18.2	0.61	0.17	20.1	20.9
+200	+ 75	6.1	0.20	0.07	2.2	2.9
+270	+ 53	11.1	0.12	0.06	2.4	4.5
+400	+ 38	5.9	0.09	0.06	1.0	2.4
-400	- 38	26.1	0.18	0.19	8.5	33.4
Total	(calc)	100.0	0.55	0.15	100.0	100.0

MINERAL IDENTIFICATION

The X-ray diffractometer analysis indicated that the sample received contains major amounts of dolomite and calcite, minor amounts of quartz and traces of pyrite and sphalerite. Similarly, the X-ray diffractometer analysis of heavy liquid concentrate indicated sphalerite and trace amounts of galena and marcasite, by contrast. Optical microscopy indicated a significant amount of marcasite.

MINERAL QUANTITIES

The quantities of all minerals identified were determined in the two samples using the image analysis system (see Table 2). Discrimination between marcasite and pyrite is impossible on this system so the proportion of pyrite to marcasite was estimated by eye using the ore microscope and it is roughly one to one.

Table 2. Mineral quantities in Pine Point tailings (wt %)

Sample	Dolomite	Calcite	Pyrite + Marcasite	Sphalerite	Galena
Tailings	73.8	23.0	2.0	0.9	0.3
Tailings Sink	3.6	2.6	34.3	52.7	6.8

MINERAL ASSOCIATION

In the sink sample SEM analysis revealed that the Pb, Zn mineral associations were:

sphalerite - dolomite
sphalerite - calcite
sphalerite - pyrite
sphalerite - marcasite
sphalerite - galena
galena - calcite

LIBERATION CHARACTERISTICS OF Pb, Zn MINERALS

The distribution of sphalerite among the grain classes is shown in Fig. 1. Particles containing 100% of the mineral are "free", but particles with as little as 70% may be recovered in the concentrate, therefore for purposes of this report particles with more than 80% of the mineral will be considered as free grains. The data in Table 3 show this range for sphalerite and galena grains. The quantity of sphalerite which is reported as 100% free in Table 2 was calculated as the difference between the quantity of total sphalerite and the sphalerite which is locked with either pyrite/marcasite or carbonate or both gangue types; similarly for galena. Therefore, in this case, any grains consisting of only galena and sphalerite are considered free and are included in the sum.

Table 3. Liberation characteristics of Pb, Zn minerals

Mineral	Liberation grain class	% Liberation of total mineral
Sphalerite	100%	6
	90% - 100%	33
	80% - 100%	40
Galena	100%	21
	90 - 100%	23
	80 - 100%	23

The distributions of the locked sphalerite and the locked galena with respect to those three gangue types are shown in Table 4. The distributions of the locked sphalerite among the grain classes for the three gangue types and total gangue are shown in Fig. 2. The distribution of the locked galena among the grain classes for total gangue is shown in Fig. 3.

Size distributions of various classes of sphalerite and galena grains are shown in Tables 5 and 6.

Table 4. Distribution of the locked ore minerals (wt %)

Ore Mineral	Gangue		
	Carbonates only	Pyrite/marcasite only	Carbonates and Pyrite/marcasite
Sphalerite	24	23	53
Galena	34	16	50

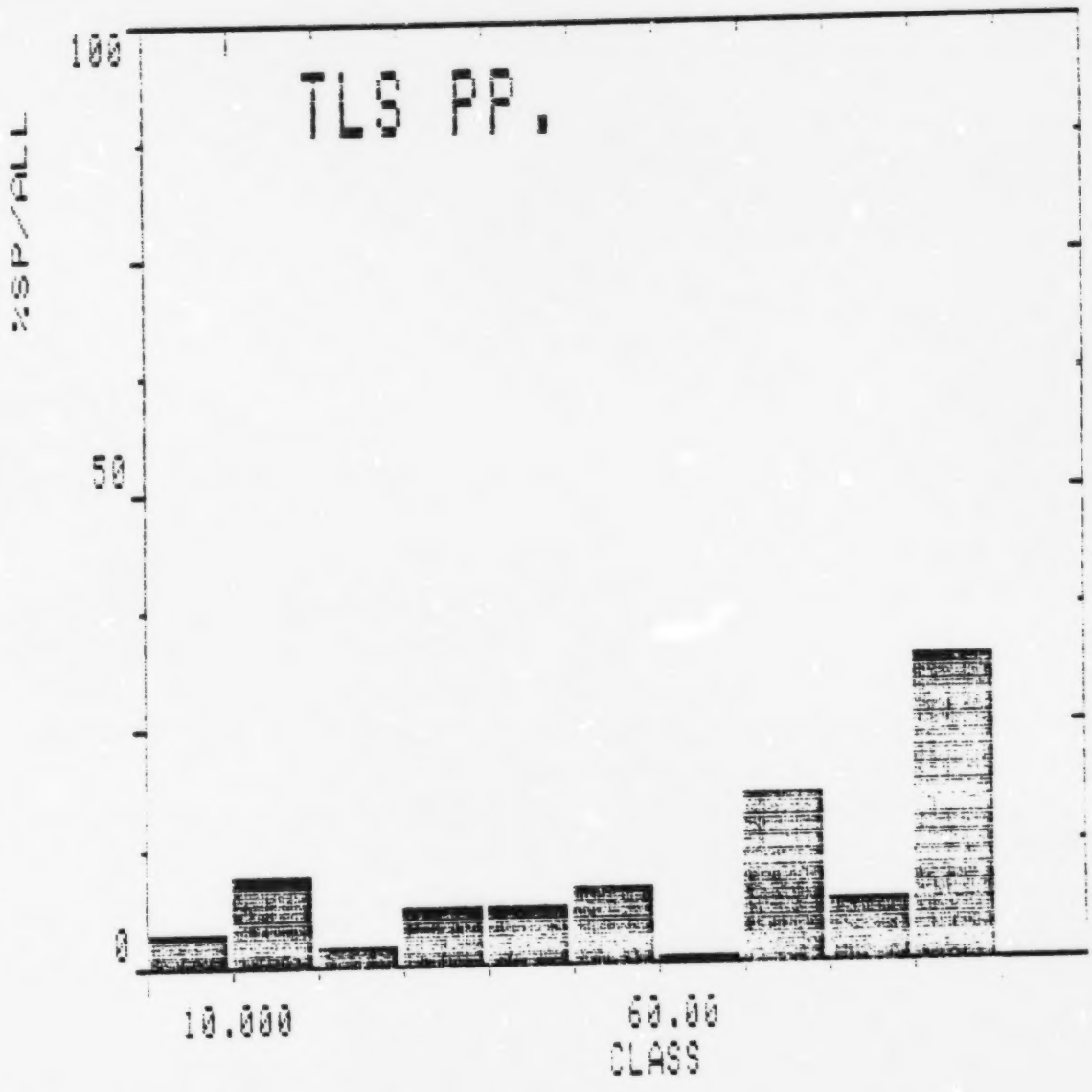

Fig. 1. Distribution of sphalerite by grain class. Grain class refers to the type of particle that, in polished section, contains the specified area % sphalerite.

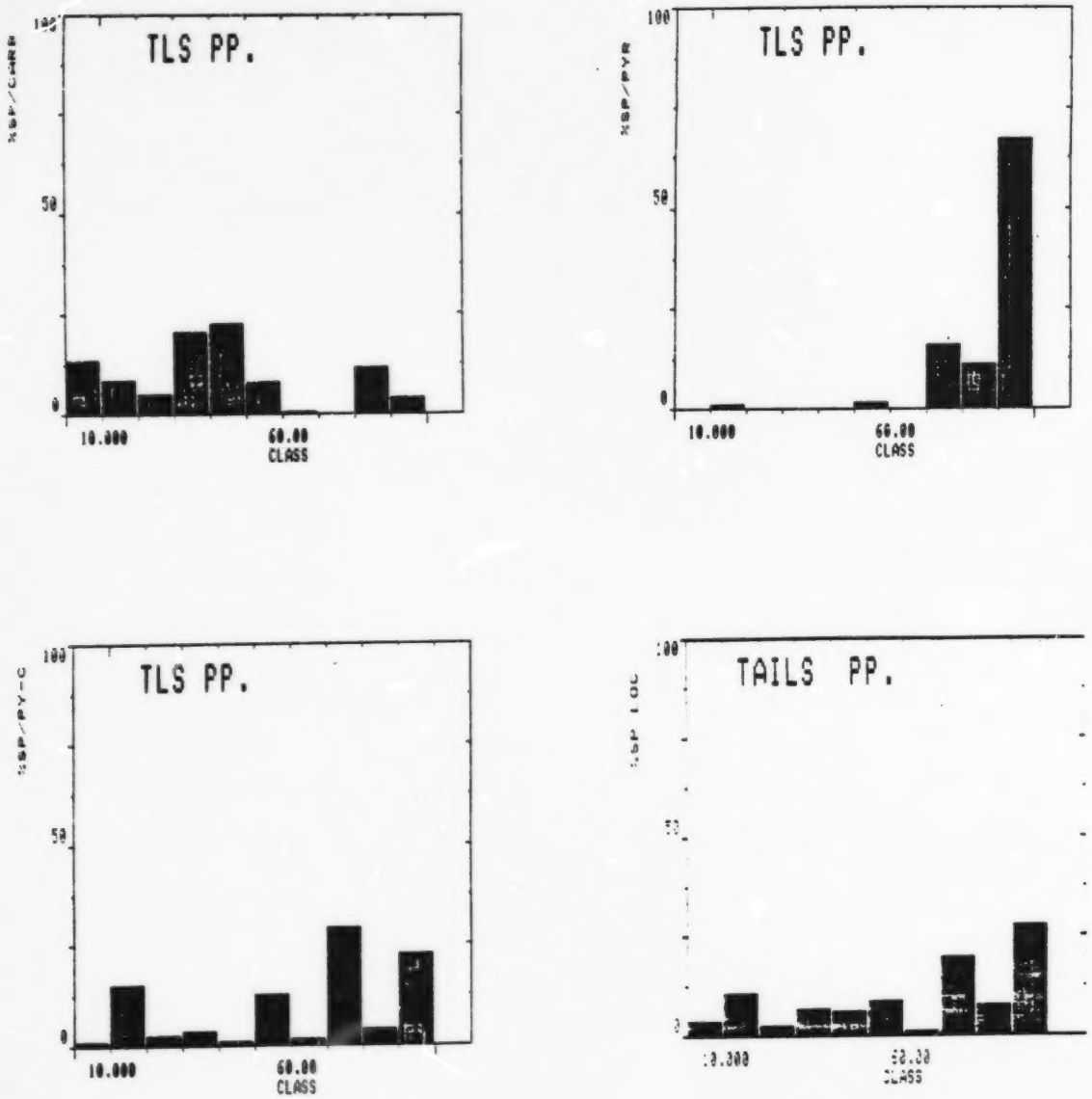

Fig. 2. Distribution of locked sphalerite by grain class for the three gangue types and total gangue. Grain class refers to the type of particle that in polished section contains the specific area % sphalerite

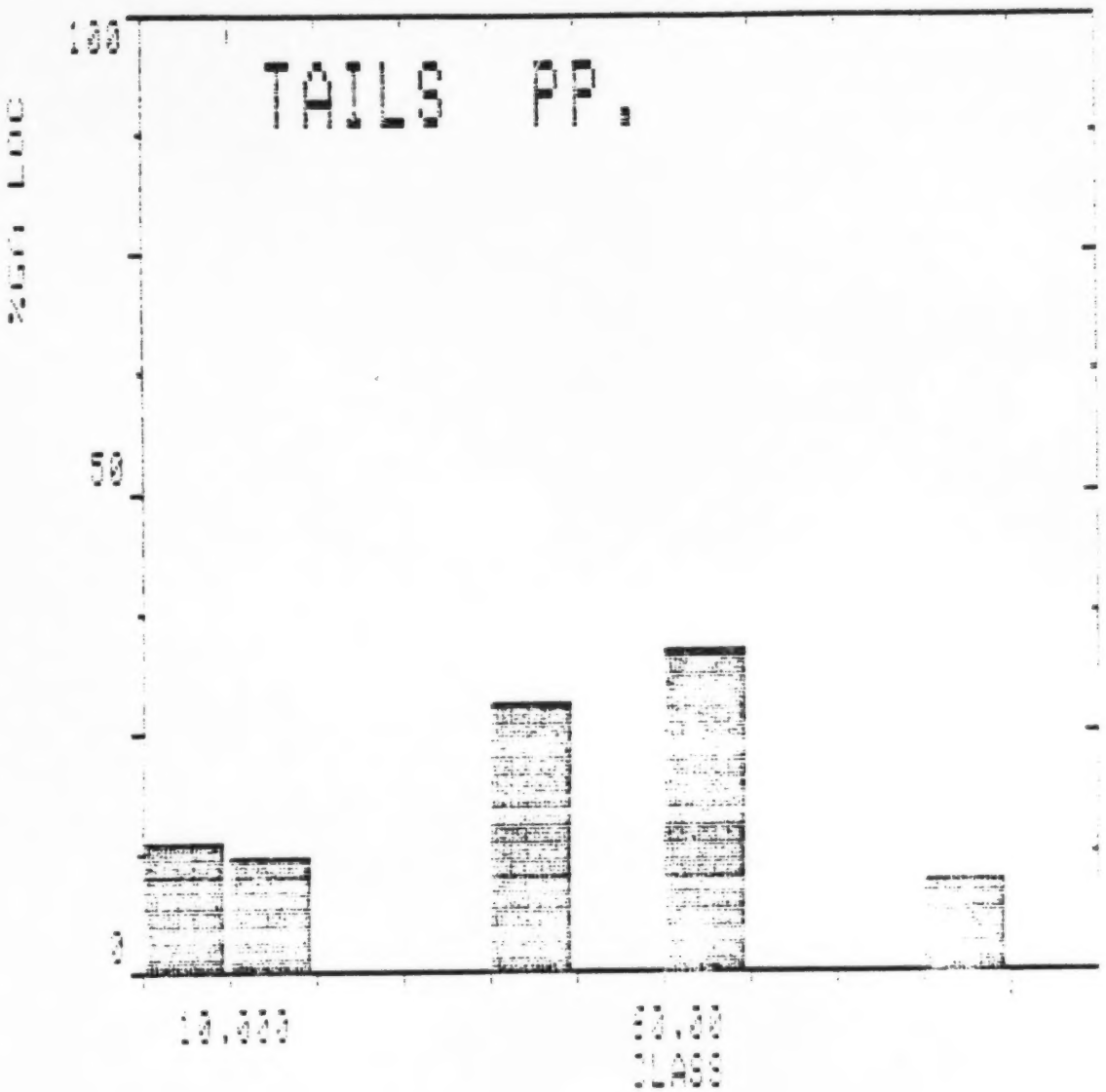

Fig. 3. Distribution of locked galena by grain class for total gangue. Grain class refers to type of particle that, in polished section, contains the specified area % galena

Table 5. Sphalerite grain size distribution in Pine Point tailings (wt %)

Size µm	All Sphalerite	Free Sphalerite	Locked Sphalerite	Locked With Carbonates	Locked With Py/Mar	Locked With Carb + Py/Mar
-3.25	Nil	Nil	Nil	Nil	Nil	Nil
-4.60	Nil	Nil	Nil	Nil	Nil	Nil
-6.5	Nil	Nil	Nil	Nil	Nil	Nil
-9.2	.02	0.02	Nil	Nil	Nil	Nil
-13.0	.62	0.29	0.13	0.12	Nil	Nil
-18.5	1.11	0.43	0.49	0.28	0.06	0.15
-26	2.97	1.02	1.69	1.29	0.14	0.26
-37	5.00	0.71	4.32	1.87	0.70	1.75
-52	6.81	1.16	5.72	2.79	0.95	1.98
-74	8.21	Nil	7.57	3.23	Nil	4.34
-104	11.63	1.36	10.40	4.01	2.83	3.56
-147	41.60	1.18	41.65	8.93	16.91	15.81
-208	7.37	Nil	7.31	Nil	Nil	7.31
+208	14.67	Nil	14.55	Nil	Nil	14.55
Total	100.00	6.18	93.82	22.52	21.58	49.72

Table 6. Galena grain size distribution in Pine Point tailings (wt %)

Size µm	All Galena	Free Galena	Locked Galena	Locked With Carbonates	Locked With Py/Mar	Locked With Carb + Py/Mar
-3.25	Nil	Nil	Nil	Nil	Nil	Nil
-4.60	Nil	Nil	Nil	Nil	Nil	Nil
-6.5	Nil	Nil	Nil	Nil	Nil	Nil
-9.2	.09	Nil	0.09	0.09	Nil	Nil
-13.0	.33	Nil	0.12	0.12	Nil	Nil
-18.5	1.42	1.00	0.82	0.82	Nil	Nil
-26	1.58	1.81	0.68	0.68	Nil	Nil
-37	2.99	Nil	Nil	Nil	Nil	Nil
-52	6.05	Nil	6.05	6.05	Nil	Nil
-74	14.10	18.11	5.09	Nil	5.09	Nil
-104	51.59	Nil	44.37	18.93	7.93	17.51
-147	21.85	Nil	21.85	Nil	Nil	21.85
-208	Nil	Nil	Nil	Nil	Nil	Nil
+208	Nil	Nil	Nil	Nil	Nil	Nil
Total	100.00	20.92	79.08	26.70	13.02	39.36

DISCUSSION

An examination of Tables 4 and 5 and Fig. 2 and 3 reveals the following:

1. Most of the locked sphalerite is coarse grained, i.e. 79% is +74 μm.

2. The locked sphalerite is mainly (>56%) in host grains containing at least 70% sphalerite.

3. A small proportion of the sphalerite (≈20%) is in host grains containing less than 30% sphalerite.

4. Most of the locked galena is coarse grained, 84% +74 μm, although this observation is based on only fifteen locked galena grains detected.

5. Roughly 10% of the locked galena is in grains containing at least 70% galena.

6. Roughly 25% of the locked galena is in grains containing less than 30% galena.

CONCLUSIONS

1. Table 3 indicates that 40 wt % of the sphalerite and 20 wt % of the galena is already recoverable. These quantities represent a loss to tailings due to normal inefficiency in the flotation process.

2. 90% of the sphalerite and 93% of the galena in the tails would be liberated by grinding to 100% -74 μm.